Automatic Genre Classification: A Study of the Viability of High-Level Features for Music Classification

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Goals

- Demonstrate power of high-level musical features by successfully using them to classify symbolic recordings by genre
- Show effectiveness of large feature libraries when combined with effective feature selection
- Demonstrate that automatic genre classification has potential with realistically large taxonomies

Methodology

- Compiled a catalogue of 160 high-level features
- Collected 950 MIDI recordings for training and testing
- Used sophisticated combination of neural networks and k-nearest neighbour classifiers
- Performed feature selection and weighting with genetic algorithms
- Developed an easy to use and flexible GUI

Results

- 86% success with 9 leaf categories
- 57% success with 38 leaf categories

Applications of automatic genre classification

- Automatic classification of large dynamic on-line music databases
- Aid to musicological and psychological research on genre
- Techniques can be applied to other types of classification:
    - Performer or composer style, geographical, cultural or temporal influences, mood, character, personal preferences

Features

Overview

- Catalogue of 160 high level features compiled (111 implemented)
  - Applicable to types of research other than genre classification
- Acquired information on which features were most important in which taxonomical contexts using automatic feature weighting
- Avoided features dependant on specialized theoretical models

Reasons for using high-level musical features recordings rather than features based on signal processing

- Have relevance to musicological and analytical studies of genre
- Take advantage of abstractions that have proven usefulness to musical experts (e.g. musicians, theorists and composers)
- Can use optical music recognition to classify scores when no audio recordings available
- Research can be adapted to audio classification as automatic transcription techniques improve

Types of features implemented

- **Instrumentation:** Which instruments were present and which ones were given particular importance. Relative importance of pitched and non-pitched instruments.
- **Texture:** Number of independent voices, their interactions and the relative importance of different voices and registers.
- **Rhythm:** Time intervals between note attacks and durations of notes. Meter, use of rubato and other rhythmic variations.
- **Dynamics:** Average loudness and variability in dynamics.
- **Pitch Statistics:** Occurrence rates of different notes, range, degree of tonality and variety of pitches.
- **Melody:** Frequencies and variability of melodic intervals, types of melodic contours and types of phrases.
- **Chords:** Types and frequencies of vertical intervals and vertical note densities.

Genre Taxonomies

Overview

- Used a hierarchical taxonomy with two important modifications:
  - A recording could belong to more than one category
  - A category could be a child of more than one parent
- Based on All Music Guide, retailers, magazines and fan sites

Small taxonomy for comparing this system to existing systems:

Jazz
- Bebop
- Jazz Soul
- Swing

Popular
- Rap
- Punk
- Country

Western Classical
- Baroque
- Modern Classical
- Romantic

Large taxonomy for testing system under realistic conditions:

Country
- Bluegrass
- Contemporary
- Trad. Country

Jazz
- Bop
  - Bebop
  - Cool
- Fusion
  - Bossa Nova
  - Jazz Soul
  - Smooth Jazz
- Ragtime
- Swing

Modern Pop
- Adult Contemp.
- Dance
  - Dance Pop
  - Pop Rap
  - Techno
- Smooth Jazz

Rap
- Hardcore Rap
- Pop Rap

Rhythm and Blues
- Blues
  - Blues Rock
  - Chicago Blues
  - Country Blues
  - Soul Blues
- Funk
- Jazz Soul
- Rock and Roll
- Soul

Rock
- Classic Rock
  - Blues Rock
  - Hard Rock
  - Psychedelic
- Modern Rock
  - Alt. Rock
  - Hard Rock
  - Metal
  - Punk

Western Classical
- Baroque
- Classical
- Early Music
  - Medieval
  - Renaissance
- Modern Classical
- Romantic

Western Folk
- Bluegrass
- Celtic
- Country Blues
- Flamenco

Worldbeat
- Latin
  - Bossa Nova
  - Salsa
  - Tango
- Reggae

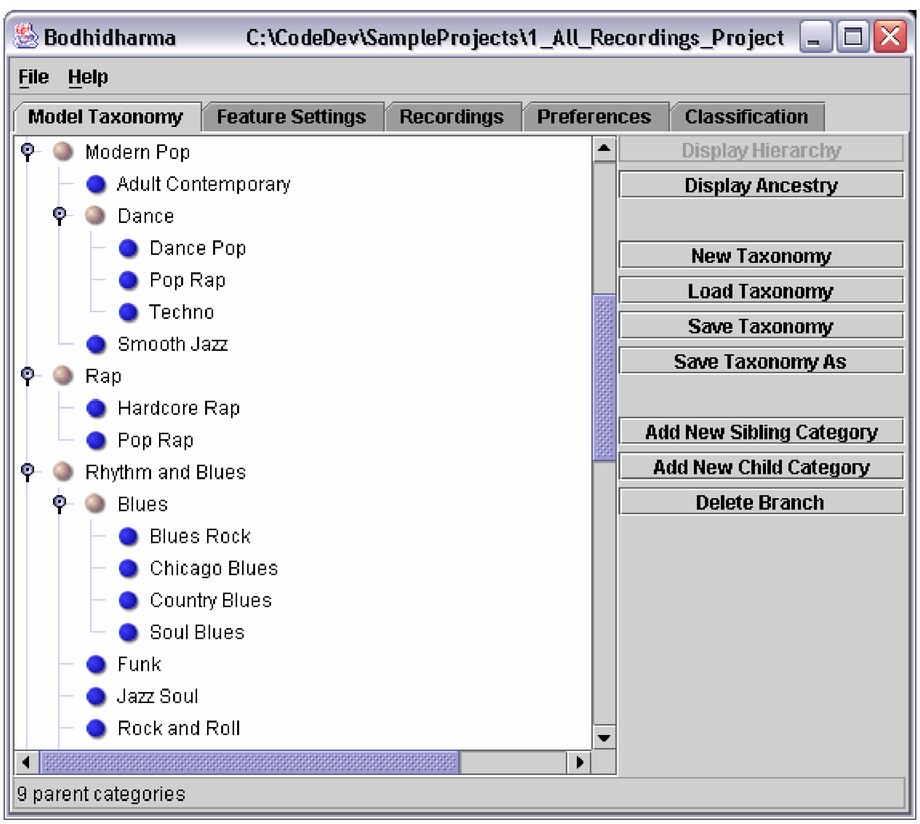
Software System

Classification system

- Used two types of classifiers:
  - K-Nearest Neighbour
    - Fast to train
  - Feedforward Neural Networks
    - Can model sophisticated relationships between features
- Used a combination of three classification methodologies:
  - Hierarchical
  - Round Robin
  - Flat
- Feature selection and weighting performed using genetic algorithms
  - Made it possible to make specialized classifiers using only features ideally suited to particular classification contexts

Interface

- Designed to be easy to use for people with little technical background
- Highly customizable
  - Configurations stored in XML files grouped into projects

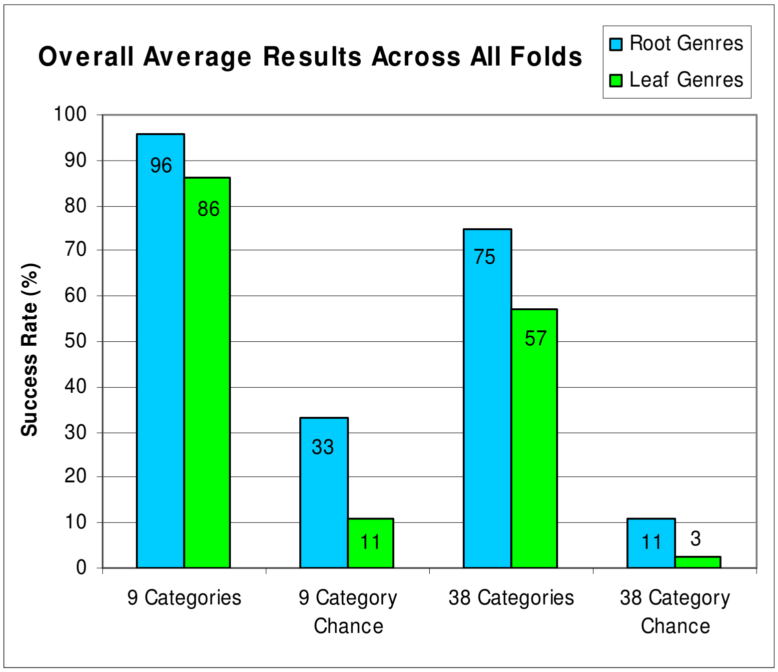


Experimental Results

Experiment

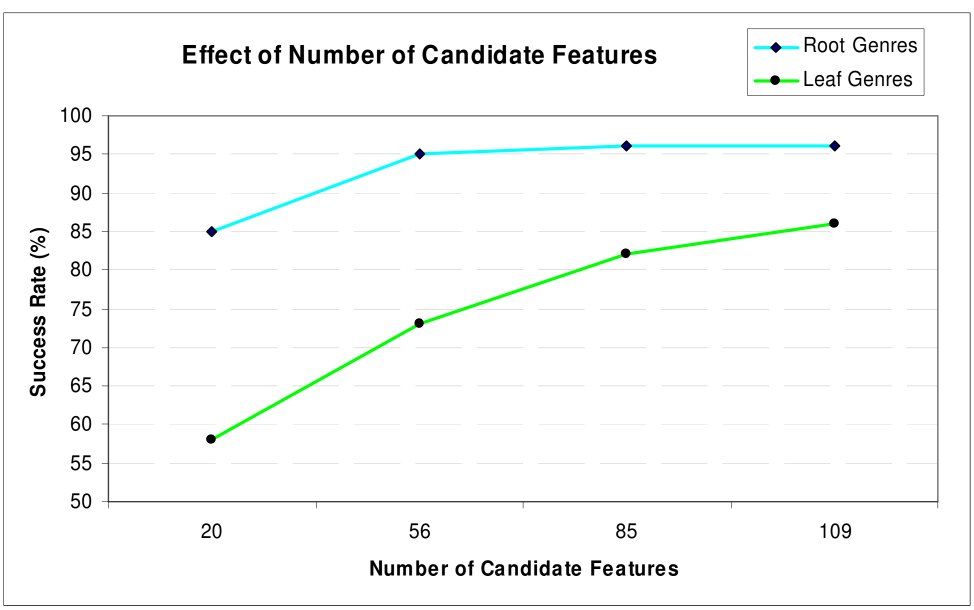
- 950 MIDI files for training and testing
- 5 fold cross-validation

Classification results



Investigation of importance of a using a large feature library

- Examined effect on success rate of only providing subsets of feature catalogue as candidates to feature selection system



Conclusions

Effectiveness of system

- Success rates with 9 category taxonomy:
  - 86% among 9 leaf categories
    - 96% among the 3 root categories
  - Much better success rates than previous systems dealing with symbolic recordings
  - Comparable with the best results involving audio recordings
- Success rates with 38 category taxonomy:
  - 57% among 38 leaf categories
    - 75% among the 9 root categories
  - No previous research has attempted to classify recordings using such a difficult taxonomy
- Results particularly encouraging considering dealt with added complication that recordings could belong to an unknown number of categories

Additional conclusions

- Effectiveness of high-level features clearly demonstrated
- A large feature library combined with good feature selection improves results
- Not yet at a point where can effectively deal with large realistic taxonomies, but are approaching that point

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